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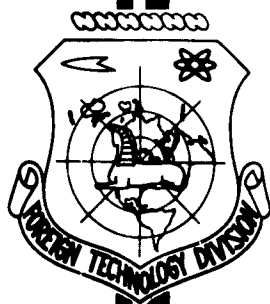
## TRANSLATION

FIRST SEMINAR AT THE DEPARTMENT OF TECHNICAL SCIENCES OF THE  
ACADEMY OF SCIENCES UKr-SSR ON SURFACE DIFFUSION  
SATURATION OF METALS AND COATINGS OF HIGH  
MELTING COMPOUNDS ON METALLIC AND  
NONMETALLIC MATERIALS

By

O. P. Yepik

## FOREIGN TECHNOLOGY DIVISION



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FIRST SEMINAR AT THE DEPARTMENT OF TECHNICAL SCIENCES  
OF THE ACADEMY OF SCIENCES UKR-SSR ON SURFACE DIFFUSION  
SATURATION OF METALS AND COATINGS OF HIGH MELTING  
COMPOUNDS ON METALLIC AND NONMETALLIC MATERIALS

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PREPARED BY:

TRANSLATION DIVISION  
FOREIGN TECHNOLOGY DIVISION  
WP-APB, OHIO.

First Seminar at the Department of Technical Sciences of the Academy  
of Sciences Ukr-SSR on Surface Diffusion Saturation of Metals and Coatings  
of High Melting Compounds on Metallic and Nonmetallic Materials

by

O. P. Yepik

On March 22-23 1962 in the city of Kiev was held the first seminar on surface diffusion saturation of metals and coatings from high melting compounds on metallic and nonmetallic materials, organized on the initiative of the Department of Techn. Sciences of the Academy of Sciences Ukr-SSR and the Odessa Polytechnicum.

In the functions of the seminar participated more than 80 specialists from 22 scientific-research organizations, higher educational institutions and industrial enterprises of Moscow, Kiev, Odessa, Sverdlovsk, Kra'kov. In addition there were also representatives from the Ceramet and Special Alloys Inst. at the Academy of Sciences Ukr-SSR, from the Inst. of Metallophysics of the Academy of Sciences Ukr-SSR, from the Kiev Polytechnicum, Odessa Polytechnicum, Khar'kov Physico-Techn. Inst. of the Academy of Sciences Ukr-SSR, Moscow Steel Inst, Moscow S. Ordzhonikidze Aviation Institute and others.

The main attention of the seminar was devoted to theoretical bases and practical formation by various methods of protective surface coatings on metal and nonmetallic materials. A total of eleven scientific reports and announcements has been presented.

In the opening speech the head of the Technical Sciences Department of the Academy of Sciences Ukr-SSR, member correspondent of the Acad. of Sc. Ukr-SSR G. V. Samsonov discussed organizational problems and functions, which are facing the seminar. He emphasized that <sup>to</sup> the problem of surface diffusion saturation of metals and coatings of high melting compounds on metallic and nonmetallic materials has been devoted a greater number of reports not only in the USSR but also abroad. This is explained by the fact, that diffusion saturations of alloys and coating of high melting compounds is not only

effective but, in many instances, the only way of retaining products with special physico-chemical and mechanical properties in good working order. Such surface layers, which improve hardness, wear resistance, heat resistance, corrosion resistance of materials in aggressive gas and liquid media, and also have a series of valuable semi-conductive and electrophysical properties, should play an important role in the development of a number of corresponding branches of industry.

However, in the experiments on surface coating there is a certain discrepancy in results, poor coordination and cooperation between interested organizations, insufficient exchange of experience and discussions of obtained results. The purpose of the seminar is to remove the shortcomings. One of the important tasks, confronting the participants of the seminar, is to combine their efforts for the development of theoretical bases and progressive methods for producing, on metallic and nonmetallic materials, surface layers of given properties.

The speaker suggested such an organization of the seminar.

The controlling organ of the seminar should be a scientific-technical council headed by a chief and two scientific secretaries which will formulate perspective plans of the most important results on surface diffusion saturation of metals and coating with high melting compounds, to coordinate the operations of organizations, which take part in the seminar, to review the requirements of industry so as to include them in their activities; to organize not more than two annual conferences of the seminar, to interest in the functions of the seminar new participants etc. Organizations taking part in the functions of the seminar, should aid each other in investigations and materials, exchange data and informations, work on the systematization and generalization of experimental and literature material collected by them for the purpose of publishing text books and monographies.

The proposed organizational scheme of seminar organization was principally praised by its participants. The seminar elected a scientific technical council of 12 people, representing 9 organizations, which participated in the seminar.

In two reports by G.V.Zemskov (Odessa Polytechnicum) were discussed methods of intensifying chemico-thermal treating processes with application of high frequency streams (SVCH), as well as perspectives of investigating multicomponent diffusion alloyed surface of alloys.

It was shown, that during nitriding and chrome-silicon plating of steel with the application of ultra-sound and SVCH, the processes which lead to the formation of diffusion surface layers and their properties (hardness, adhesion with base) appear to be better than the conventional chemico-thermal treating processes. It was pointed out, that the number of investigations on chemico-thermal treating with application of ultra-sound and SVCH is still insufficiently explained in domestic and foreign literature, and especially, in the branch, for revealing the physical nature of phenomena, originating under the effect of SVCH and ultra sound, and that to this alone special attention should be devoted in the forthcoming functions.

The study of problems on multicomponent diffusion surface alloying of alloys was taken up immediately in the initial stages, but only by directly studying these problems is it possible to obtain the highest exploitational characteristics of surface layers (heat resistance, erosion resistance in gaseous media, heat resistance and fire resistance). In this branch, in addition to the necessity of accumulating factual material, it is also necessary to more thoroughly examine the theoretical bases of creating multicomponent coatings.

Two reports by G.M.Dubin (Moscow Aviation Inst) were devoted to complex alloying of alloys on molybdenum and niobium base (molybdenum and niobium base alloys) and to the study of residual stresses, which originate during the saturation of alloy surfaces with metals.

Analyzed were certain results obtained from studying complex diffusion layers, applied on molybdenum, niobium and their alloys by the thermal diffusion saturation method in specially prepared solid covers with activating admixtures. Shown is

the perspectiveness of these investigations for the protection of molybdenum and niobium against high temperature oxidation. Investigations of residual stresses, which originate in surface layers of alloys during their saturation with metals, have been carried out on the original optical-mechanical installation. The object of investigation was U10 steel, saturated from the surface with aluminum, chromium, boron, titanium and niobium. It was noticed, that in all instances residual compression stresses originate on the surface, and their magnitude is determined by the condition of diffusion, and by the ratios of the diameter of the diffusion atom to the diameter of the atom of the basic metal (the higher these ratios, the higher is residual stress). In case compression stresses do originate in the surface layer the wear resistance, strength and recrystallization temperature of layers rise. In case of tensile stresses - a reverse picture is observed: the layers crack, they become porous, their adhesion with the base decreases. In all instances the quality of saturated surface layers will be determined by the difference in thermal expansion coefficients of the basic metal, and its surface alloyed layer, as well as by the ratios of investigated volumes of basic metal and new phases, formed in the surface layer. This will enable to predict the behavior of surface layers and to select optimum pairs: basic metal and metal, with which surface alloying is done.

Yu. M. Griboyedov (Moscow, Central Scientific-Research Inst. of Technology of Machine Construction) announced the investigations of the process of nitriding of chrome plated diffusion layer of austenite steel to protect same against erosion, tear and wear. It was shown in the report, that the <sup>chrome</sup> layer applied electrolytically, a layer which later underwent special thermal processing and nitrogen saturation, considerably raises its wear resistance, corrosion resistance, tearing resistance. The technology of applying a chromium layer with subsequent nitriding of same for austenitic steel, as developed by the institute, has found broad application in industry.

The report by O. P. Yepik (Inst. of Ceramics and Special Alloys at the Acad. of Sciences



Ukr-SSR) was devoted to the study of diffusion parameters during boron and carbide plating of tungsten and molybdenum in solid phase. Determination of the activation energy of the diffusion of metalloids in metals, especially in transition, calculation of preexponential factors and temperature dependence of diffusion coefficients is important from the theoretical viewpoint (to explain the effect of electron structure of metal and metalloid atoms on the diffusion process) as well as for practice in selecting optimum conditions, assuring maximum qualitative diffusion coatings. The parameters of boron and carbon diffusion in tungsten and molybdenum have been determined and this allows further with sufficient accuracy to determine the rate of formation and thickness of diffusion layers. In the report on the basis of experimental data were made general recommendations for the selection of conditions for carbide and boron plating of tungsten and molybdenum to obtain qualitative layers.

V.M.Konev (Sverdlovsk, Ural State University) told about the accomplishments of the Ural State Univer. in the field of diffusion coatings on metals. The basic purpose of the investigations carried out by the university is the formulation of theoretical ideas about the diffusion-reaction processes in metal-active gas systems (one or several). Theoretical investigations are carried out together with experimental, a majority of which has already been published.

The speaker emphasized, that the purpose of theoretical investigations at the present state is the desire to analyze the collected factual material and to find a valid relationship between macroscopic effects, which are encountered in the experiments, and the microstructure of components, taking part in the reaction. The speaker has briefly discussed certain practical investigations, made at the university by order of industry, for the creation of carbidechromium layers on steel and silicization of molybdenum in gaseous state.

The announcements by L.V.Strashinskaya (Inst. of Ceramets and Spec. Alloys at the Academy of Sciences Ukr-SSR) were devoted to contact reaction between high melting metals and high melting compounds in solid phase at high temperatures (1600-2000°C).

In the report by O.Ya.Artamonov (Inst.of Ceramet and Spec.Alloys at the Academy of Sciences Ukr-SSR) were discussed questions of electroerosion finishing treatments of solid surfaces. The speaker discusses in detail the equipment and conditions of processing high melting compounds and the results, already collected in this field.

Interesting was the announcement of I.M.Rovinskiy (Research Lab of the Ukr-SSR State Plan) on thermochemical processing of steel and hard alloys in liquid high temperature electrolytes.

Investigation on boron treating of steel in vacuo in a solid phase bath was described by M.G.Kaydash (Odessa Polytechnicum)

All the lectures were followed by lively discussions.

The resolutions of the seminar underline the importance and cooperation as well as timely organization of a constantly working seminar on matters of surface diffusion saturation of alloys and coatings made of high melting compounds on metallic and non-metallic materials, the necessity of more thorough theoretical and practical (experimental) investigations, realized in this respect, the advisability of expanding the number of seminar participants and good organization for the exchange of experiences and information on already finished investigations.

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